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Abstracts

K. SUMIYA: **Bioelectrical Potential and Tree**, Mokuzai Kenkyu Shiryo (Wood Research and Technical Notes), No. 22, 1 (1986) (in Japanese)

All living organs have a negative bioelectrical potential against their surroundings. The changes of these potentials reflect ion-fluxes across cell membrane associated with metabolic processes. In this article, the role of plasma-membrane and the generation of bioelectrical potential are considered in higher plants. And, then, the studies on the bioelectrical potential in tree and callus induced from tree are reviewed.

K. SHIMAJI, K. SUMIYA, T. ITOH, S. HAYASHI, H. KURODA and T. AKAI: **Influence of Seasonal Changes in Crown Growth on the Development of Stem Wood**, Mokuzai Kenkyu Shiryo (Wood Research and Technical Notes), No. 22, 99 (1986) (in Japanese)

Xylem growth and crown growth of three 10 years old Japanese red pine trees (*Pinus densiflora* S. et Z.) were followed through one growing season. Time related development of cell dimensions and xylem growth in cell number was determined by periodically induced xylem wounds. Crown growth index for each stem internode was obtained by periodical measurement of the elongation rate of leader, all the first order branches, as well as that of current needles together with the respective dry weight of old and current needles on each branch whorl, as follows: $GI_j = \sum w_i GR_i / \lambda_i$ (GI_j = Crown growth index for j -internode; GR_i = Elongation rate of leader, first order branches on i -node and current needles on these branches; λ_i = Distance from i -node to the middle of j -internode; w_i = Weight factors of branch numbers and needle amounts on i -node). Xylem growth in cell number, radial diameter and wall thickness of tracheid at a certain time of growing season at a certain point on the stem and above-obtained GI_j showed a good correlation, supporting the hypotheses that the rate of cell production and cell diameter in stem wood mainly depend on the auxin transported only basipetally from elongating shoots and leaves, while cell wall thickness depends on the carbohydrates transported non-polarly from assimilating leaves.

K. SHIMAJI, S. HAYASHI and T. ITOH: **Wood**, Chap. 2 (5), Excavation of Kitashirakawa-Oiwakecho Relics, Annual Report upon Archaeological Research on the Campus of Kyoto University, 1979, Center for Archaeological Operations, Kyoto University, 32, 8 Plates (1987) (in Japanese)

Identification of tree species was carried out on the 130 ancient natural wood

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specimens unearthed from a couple of strata belonging to late Jomon era. Identified species and their numbers are as follows: [Conifers] *Torreya nucifera* (10), *Cephalotaxus harringtonia* f. *drupacea* (2), *Abies firma* (2), *Cryptomeria japonica* (1). [Dicotyledons] *Populus tremula* (1), *Quercus* sp. (Subg. *Cyclobalanopsis*) (30), *Castanea crenata* (6), *Aphananthe aspera* (9), *Morus australis* (4), *Blousonetia* sp. (6), *Illicium religiosum* (1), *Prunus jamasakura* (1), *Acer* sp. (40), *Aesculus turbinata* (3), *Sapindus mukorossi* (2), *Actinidia* sp. (7), *Clethra barbinervis* (2), *Stylax* sp. (2), Unknown (1).

S. HAYASHI and K. SHIMAJI: **Tree species of ancient wood unearthed from Sannomaru Site**, Chap. 2(5), Summarized Report of the Excavation of Sannomaru Site, Takatsuki-jo Castle Relics, Investigation Board of Takatsuki-jo Castle Relics, 25 (1987) (in Japanese)

Identification of tree species was carried out on the 20 wooden remains, such as logs and piles, unearthed around Sannomaru Site, Takatsuki-jo Castle Relics. Four samples from medieval "Ditch 1" were identified as each two of *Alnus japonica* and *Castanea crenata*. These species have not been found during the survey of Honmaru Site. For the samples from recent "Outer Moat", *Pinus* sp. (*Diploxylon*) (6), *Cryptomeria japonica* (4), *Chamaecyparis obtusa* (3), *Castanea crenata* (1), *Certis sinensis* var. *japonica* (1) and *Prunus sargentii* ssp. *jamasakura* (1) were identified. Remains of *Chamaecyparis obtusa* bore evidences of artificial processing for building construction, suggesting that these were diverted from abolished buildings.

S. HAYASHI and K. SHIMAJI: **Tree species of wooden implements unearthed from Nagano A Relics**, Report of Buried Cultural Treasures in Kitakyushu City, No. 54, Nagano A Relics 2, 303, Plate 1 (1987) (in Japanese)

Identification of tree species was carried out on the 49 wooden implements unearthed from the strata corresponding to late Kofun to Kamakura eras, and correlations between identified species and their utilization were discussed. Among 49 specimens, 26 were conifers (5 species) and 23 were angiosperms (12 species). Among 5 species of conifers, *Cryptomeria japonica* (10 specimens) and *Chamaecyparis obtusa* (11 specimens) were dominant, the former chiefly being used for construction, and the latter for round chip boxes and likes taking advantage of its elastic property. Utilization of dicotyledons was also found to be "right material for right use", e.g. for tools demanding hardness and strength such as plows, mallets and combs, *Quercus* sp. (Subgen. *Cyclobalanopsis*), *Eurya japonica* and *Cameria japonica* were selected respectively.

S. HAYASHI and T. NOMURA: **Anatomy and Properties of Tropical Woods. Manual IV-Anatomy of 31 Sri Lanka Wood Species**, Mokuzai Kenkyu Shiryo

(Wood Research and Technical Notes), No. 22, 112 (1986) (in Japanese)

The fourth report of a series of the research on anatomy and properties of tropical woods to supply the basic informations for reasonable utilization of woods.

Thirty one Sri Lanka wood species are briefly mentioned on their distribution, uses, characters (color, grain, figure, specific gravity and hardness) and anatomical features with color pictures of appearance and microscopic pictures of cross-, radial- and tangential sections (40 \times).

S. HAYASHI: List of Species Represented by Wood Specimens in the Xylarium, Wood Research Institute, Kyoto University (KYOW) No. 8001-10000, Mokuzai Kenkyu Shiryo (Wood Research and Technical Notes), No. 22, 158 (1986) (in Japanese)

Our wood collection is rapidly expanding by the exchange of authentic wood samples with institutional wood collections all over the world. Collections of domestic wood samples and their herbarium vouchers are also proceeding extensively, and total number of our wood samples amounts over 11,800 at present. This consists of the botanical names of KYOW samples No. 8001 to 10000 in the alphabetical order of the families, genera and species, containing 112 families, 518 genera and 1222 species. Exchange is available for fairly large number of domestic samples. Small blocks for sectioning are also available for almost all samples.

T. ITOH: Formation of Cellulose Microfibrils, Electron Microscope, 21(2), 121-128 (1986) (In Japanese)

Current concept on the formation of cellulose microfibrils is reviewed in the paper based on the recent results obtained by the freeze fracture technique. The paper is divided into 9 brief chapters, including (1) introduction, (2) the site on the formation of cellulose microfibrils, (3) terminal cellulose synthesizing complexes (TCs), (4) TCs move in the plasma membrane, (5) TCs in *Valonia* and the deposition of microfibrils, (6) shape of TCs, (7) TCs and the inhibitor of cellulose microfibrils, (8) control on the orientation of cellulose microfibrils and (9) conclusion.

T. ITOH: Microfibril Assembly in Giant Marine Algae, TAPPI Proceedings of International Dissolving Pulps Conference, 117-120 (1987)

The structure and development of putative cellulose synthesizing complexes (TCs) were investigated in giant marine algae. Among the giant marine algae, 8 species from 7 genera in the siphonocladales and one species in the cladophorales have linear TCs on both EF and PF faces of the plasma membrane. This paper

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presents new evidence for TCs on both membrane faces in *Boodlea composita*, *Dictyosphaeria cavernosa*, *Siphonocladus tropicus*, *Struvea elegans* and *Valonia ventricosa*. The mean length of TCs among those algae during secondary wall synthesis ranges from 400 to 600 nm. Contrary to a fairly consistent width, TCs have a wide distribution of length among individual species, including various stages of development within the same species. Most of the TCs have a random arrangement of subunits as well as 3 rows.

It is evident from the time course experiments of TC development that the TCs initiate *de novo*, increase their length during primary wall synthesis, and stop their increase in length after secondary wall synthesis begins. The evidence demonstrates that linear TCs are not an artificial products but dynamic entities which are involved in the assembly of cellulose microfibrils.

K. KUDLICKA, A. WARDROP, T. ITOH and R.M. BROWN, Jr.: **Further evidence from sectioned material in support of the existence of a linear terminal complexes in cellulose synthesis**, *Planta* **136**, 96-103 (1987)

Transmembrane linear terminal complexes considered to be involved in the synthesis of cellulose microfibrils have been described in the plasma membrane of *Boergesenia forbesii*. Evidence for the existence of these structures has been obtained almost exclusively using the freeze etching technique. In the present study an attempt has been made to complete these studies using conventional fixation, staining, and sectioning procedures. In developing cells of *Boergesenia forbesii*, strongly stained structures traversing the plasma membrane and averaging $598.9 \text{ nm} \pm 171.3 \text{ nm}$ in length, $28.7 \text{ nm} \pm 4.2 \text{ nm}$ in width, and $35.2 \text{ nm} \pm 6.6 \text{ nm}$ in depth have been demonstrated. These structures are considered to be linear terminal complexes. At their distal (cell wall) surface, they appear to be closely associated with cellulose microfibrils. At the proximal (cytoplasmic) surface, they are associated with microtubules and polysomes. A model of the possible interrelation of the terminal complexes and microtubules leading to the generation of cell wall microfibrils is proposed.

T. ITOH: **Assembly of cellulose microfibrils among selected green algae**, Abstracts of XIV International Botanical Congress, 196 (1987)

The development of linear cellulose synthesizing complexes (=TCs) of selected siphonocladalean algae was investigated by following the time course of the regeneration of cell walls with the freeze fracture technique after aplanospore induction. The following structural changes of TC development were observed: (1) Ts initiate *de novo*; (2) the first nucleation of TC subunits occurs within 2 hr in *Boergesenia* and 5 hr in *Valonia* after aplanospore induction, immediately followed

by the assembly of random microfibrils; (3) TCs increase their length during the assembly of random microfibrils; and (4) TCs stop increase in length after the assembly of ordered microfibrils begins. The data demonstrate that linear TCs are not an artificial products but dynamic entities which are involved in the assembly of cellulose microfibrils. Orientation of microtubules was also examined by the immunofluorescence microscopy during the time course of cell wall regeneration in *Boergerenia forbesii*.

F. TANAKA and T. KOSHIJIMA, **Estimation of the conformation of (1→4)- α -D-galactan**, Mokuza Kenkyu Shiryo (Wood Research and Technical Note), No. 22, 46-52 (1986)

The conformation analysis for (1→4)- α -D-galactan was carried out with the use of packing analysis. From the repulsive potential energy calculation, the best conformation model was obtained. It was a 2_1 helix with 8.90 Å fiber repeat. The most stable position of O6 oxygen was the gt one.

F. TANAKA, Y. MIZOGUCHI, Y. SHUTO, K. OKAMURA, K. OGAWA and T. KOSHIJIMA: **Estimation of the conformation of (1→4)- β -D-galactan**, Mokuza Kenkyu Shiryo (Wood Research and Technical Note), 22, 37-45 (1986)

The conformation analysis for (1→4)- β -D-galactan was carried out with the use of packing analysis. From the potential energy calculation, the best conformation model was obtained. It was a 6_1 helix with 19.2 Å fiber repeat. The most stable position of O6 oxygen was the tg one.

A. KATO, J. AZUMA and T. KOSHIJIMA: **Björkman LCC from sugar-cane bagasse**, Mokuza Gakkaishi, 33, 487 (1987)

Björkman LCC was isolated from sugar-cane bagasse and separated into three fractions (C-I-M, C-I-A, and C-I-R) by means of DEAE-Sephadex A-50 column chromatography. Their chemical compositions were 73.1% neutral sugar, 0.9% uronic acid, and 21.6% lignin in C-I-M, 77.3%, 5.5%, and 10.3%, respectively, in C-I-A, and 49.9%, 2.0%, and 38.5%, respectively, in C-I-R. The carbohydrate portion of C-I-M was composed of arabinoxylan and (1→3, 1→4)-D-glucan, and those of C-I-A and C-I-R were mainly arabinoglucuronoxylan. Parts of L-arabinofuranose pendants were substituted further with other sugars or lignin. The Björkman LCC fractions also contained 2.2~5.2% phenolic acid comprised of p-coumaric and ferulic acids. Ninety-four to 98% of the p-coumaric acid was recovered as monomeric units by saponification, whereas 12 to 27% of the ferulic acid could not be released by this treatment. Additional acidolysis in dioxane-water was needed to release the remaining ferulic acid, indicating the presence

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of an ether linkage between ferulic acid and lignin.

A. KATO, J. AZUMA and T. KOSHIJIMA: **Isolation and identification of a new ferulosylated tetrasaccharide from bagasse lignin-carbohydrate complex containing phenolic acid**, Agric. Biol. Chem., **51**, 1691 (1987)

A new method for isolating feruloylated oligosaccharides from the enzymatic hydrolysate of bagasse lignin-carbohydrate complex containing phenolic acids was presented. Two feruloylated oligosaccharides (FAX₂ and FAX₃) were separated from free sugars by adsorption chromatography on Sephadex LH-20, and purified by preparative thin layer chromatography, and gel filtration chromatography on Sephadex G-10. The primary structure of FAX₂ and FAX₃ were identified as *O*-[5-*O*-(*trans*-feruloyl)- α -L-arabinofuranosyl]-(1 \rightarrow 3)-*O*- β -D-xylopyranosyl-(1 \rightarrow 4)- β -D-xylopyranose and *O*-[5-*O*-(*trans*-feruloyl)- α -L-arabinofuranosyl]-(1 \rightarrow 3)-[*O*- β -D-xylopyranosyl-(1 \rightarrow 4)]-*O*- β -D-xylopyranosyl-(1 \rightarrow 4)-D-xylopyranose, respectively, by chemical compositional methylation and IR and NMR spectroscopic analyses. Oligosaccharide moieties of FAX₂ and FAX₃ were prepared by saponification and their structures were also identified as *O*- α -L-arabinofuranosyl-(1 \rightarrow 3)-*O*- β -D-xylopyranosyl-(1 \rightarrow 4)-D-xylopyranose and *O*- α -L-arabinofuranosyl-(1 \rightarrow 3)-[*O*- β -D-xylopyranosyl-(1 \rightarrow 4)]-*O*- β -D-xylopyranosyl-(1 \rightarrow 4)-D-xylopyranose, respectively.

S. FUJISHIMA, F. YAKU and T. KOSHIJIMA: **Recovery and reutilization of cellulases used for the hydrolysis of woods IV.**, Mokuzai Gakkaishi, **33**, 50 (1987)

The adsorption of cellulases from *Trichoderma viride* and *Aspergillus niger* was studied during the hydrolysis of finely-divided wood meal. By measuring three cellulase activities, it was found that the adsorption of cellulases on the wood meal was not affected by extraction with ethanol-benzene and the conditions of vibratory ball-milling. On the other hand, it was different among wood species Karamatsu (*Larix leptolepis* Gord.) was notable in adsorbing cellulase activities, especially that of β -glucosidase. The desorption of β -glucosidase from the residual wood meal of karamatsu having cellulase activities was 10% of the adsorbed one when it was shaken in a buffer solution (pH 4.5) at 40°C. However, the β -glucosidase activity on karamatsu residue was 88% of the original one. These results suggest that the cellulases adsorbed on residual wood-meal remain immobilized on the substrate.

T. WATANABE, S. KAIZU and T. KOSHIJIMA: **Binding Sites of Carbohydrate Moieties toward Lignin in Lignin-Carbohydrate Complex from *Pinus densiflora* Wood**, Chem. Lett., **1986**, 1871

Partially enzyme-degraded lignin-carbohydrate complex (LCC) was subjected to acetylation, followed by oxidation with 2,3-dichloro-5,6-dicyanobenzoquinone (DDQ), which is confirmed to decompose α - and conjugated γ -ether to release the corresponding alcohol. Methylation analysis of the liberated sugar acetates showed that glucomannan preferably binds to lignin at C-6 position of mannose and glucose residues and that arabinoglucuronoxylan at C-2 and C-3 position of xylose.

T. WATANABE, T. KOSHIJIMA and J. AZUMA: **Selective Cleavage of Carbohydrate-Lignin Bonds in Lignin-Carbohydrate Complex from *Pinus densiflora* Wood**, Proceedings of International Symp. Wood and Pulping Chem., 2, 45 (1987)

Acidic fraction of lignin-carbohydrate complex (C-1-A) isolated from *Pinus densiflora* wood was subjected to enzymatic hydrolysis using two types of purified cellulase preparations. Adsorption chromatography of the hydrolyzates on a Toyopeal HW-40S column resulted in isolation of LCC fragments (A-ESD). To elucidate binding sites between lignin and carbohydrate, the enzyme-degraded LCC fragments (A-ESD) were subjected to acetylation, followed by oxidation with 2,3-dichloro-5,6-dicyano-*p*-benzoquinone (DDQ), which is confirmed to decompose α and conjugated γ -ether to release the corresponding alcohol. Methylation of the liberated sugar acetates with methyl trifluoromethanesulfonate gave 6-*O*-methyl glucose, 2-*O*-methyl glucose, 6-*O*-methyl mannose, 2-*O*-methyl-mannose, 2-*O*-methyl xylose and 3-*O*-methyl xylose derivatives. These results indicate that acetyl glucomannan binds to lignin preferably at C-6 position of mannose and glucose residues and arabinoglucuronoxylan at C-2 and C-3 positions of xylan main chain through α and conjugated γ -carbon atoms of the *p*-etherified lignin units.

Y. SHUTOH, K. OKAMURA, F. TANAKA and M. NORIMOTO: **Conformational Analysis of Cellulose Tripropionate**, Bulletin Kyoto University Forests, 58, 280 (1986)

The conformation of single cellulose tripropionate chain was studied by the virtual bond method considering nonbonded repulsive energy within the residue and between the contiguous residues. From X-ray data, the fiber repeat distance was found to be 1.508 nm with systematic absences of threefold screw axis along the molecule. This threefold helical symmetry of cellulose tripropionate is unique among cellulose triester homologues in which the twofold screw axis is predominant. Considering 16 most probable conformations, 8 in right-handed and 8 in left-handed helical conformations, a left-handed 3_2 helical conformation was most favorable based on conformation analysis and short contact examinations between any pair of nonbonded atoms. The propionyl side chains are considerably extended almost

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perpendicularly to the helix axis.

A. SATO: **Two Weeks Studies in East and West Malaysia**, Mokuzai Kogyo (Wood Industry), **41**, No. 10, 487 (1986). (in Japanese)

The author visited Universiti Pertanian Malaysia near Kuala Lumpur and also travelled to Sava and Sarawaku in Borneo Island under financial assist of JSPS in March last year. Through the report many observation about this country and many problems about reserch fields are described and pointed out.

A. SATO: **Science about Woody Circumstances**, Ed. by T. Yamada, Kaiseisha (1987) Partly Writing for Div. 4, Cap. 3 as the title of **Health Attacks due to Wood Extractives** (in Japanese)

Many examples of human deseases which are derived from wood extractives are described. Dermatitis and ashma are compiled with inter-action of allergy. Also, physiological view of lignanes are introduced, briefly.

T. OKAMOTO, M. SHIMADA and S. OKA: **Ethylene Formation from 1-Aminocyclopropanecarboxylic Acid by the Reaction of Molecular Oxygen and Dihydropyridine Mediated by Flavin Mononucleotide and Mn (II) Ion**, Chemistry Letters, 817 (1987)

Oxidation of 1-aminocyclopropanecarboxylic acid by O₂ in the presence of 1-benzyl-3-carbamoyl-1,4-dihydropyridine, Mn (II) ion, and flavin mononucleotide reproduced the biological ethylene forming reaction in plant tissues with respect to products, stereochemistry, and behavior to inhibitors.

T. UMEZAWA and T. HIGUCHI: **Formation of a muconate in aromatic ring cleavage of a β -O-4 Lignin Substructure Model by Lignin Peroxidase**, Agric. Biol. Chem., **51**, 2281 (1987)

Methyl muconate of arylglycerol was identified as a novel product of aromatic ring cleavage of a β -O-4 lignin substructure model dimer by lignin peroxidase of *Phanerochaete chrysosporium*. The muconate is an immediate aromatic ring cleavage product of the β -O-4 dimer.

T. UMEZAWA and T. HIGUCHI: **Mechanism of Aromatic Ring Cleavage of β -O-4 Lignin Substructure Models by Lignin Peroxidase**, FEBS Lett., **218**, 255 (1987)

This investigation examined the aromatic ring cleavage of β -O-4 lignin substructure model compounds by lignin peroxidase of *Phanerochaete chrysosporium*. Based on tracer experiments using H₂¹⁸O and ¹⁸O₂, mechanisms of the aromatic

ring cleavage of the β -O-4 lignin models were proposed. The mechanisms involve one-electron oxidation of the β -O-4 lignin models by the enzyme followed by attack of nucleophiles and radical coupling with O₂.

T. UMEZAWA and T. HIGUCHI: **Aromatic Ring Cleavage of β -O-4 Lignin Model Dimers Without Prior Demeth(ox)ylation by Lignin Peroxidase**, FEBS Lett., 205, 293 (1986)

Methyl oxalate of arylglycerol was formed as an aromatic ring cleavage product in degradation of arylglycerol- β -aryl ether (β -O-4) type lignin substructure model dimers by extracellular lignin peroxidase of *Phanerochaete chrysosporium*. The enzymatic cleavage of arylglycerol- β -(*o*-[²H₃]methoxyphenyl) ether indicated that the methyl group of the methyl ester was derived from the methoxyl group of the β -O-4 model dimer. It is thus concluded that demeth(ox)ylation was not essential for the enzymatic aromatic ring cleavage of the methoxylated aromatic substrates, β -O-4 lignin substructure models.

T. UMEZAWA, M. SHIMADA, T. HIGUCHI and K. KUSAI: **Aromatic Ring Cleavage of β -O-4 Lignin Substructure Model Dimers by Lignin Peroxidase of *Phanerochaete chrysosporium***, FEBS Lett., 205, 287 (1986)

Extracellular lignin peroxidase (ligninase) from *Phanerochaete chrysosporium* catalyzed aromatic ring cleavage of β -O-4 lignin substructure model dimers to give three esters of arylglycerol, cyclic carbonate, formate and methyl oxalate. H₂O₂ was required for the activity of the enzyme.

S. KAWAI, T. UMEZAWA and T. HIGUCHI: ***p*-Benzoquinone Monoketals, Novel Degradation Products of β -O-4 Lignin Model Compounds by *Coriolus versicolor* and Lignin Peroxidase of *Phanerochaete chrysosporium***, FEBS Lett., 210, 61 (1987)

2-(4-Ethoxy-3-methoxyphenyl)-3-hydroxymethyl-6,10-dimethoxy-1,4-dioxaspiro[4,5]deca-6,9-diene-8-one (**III**) and its isomer **IV** were identified as catabolites of 4-ethoxy-3-methoxyphenylglycerol- β -syringaldehyde ether (**I**) by the culture of *Coriolus versicolor*. Compound **III** was also produced from 4-ethoxy-3-methoxyphenylglycerol- β -syringic acid ether (**II**) by lignin peroxidase of *Phanerochaete chrysosporium*. An isotopic experiment showed that molecular oxygen was incorporated into the quinone oxygen of **III** in the degradation of **II** by lignin peroxidase.

T. KATAYAMA, M. SOGO and T. HIGUCHI: **Side Chain Reactions of Syringylcoumarone and Propiosyringone Derivatives in the Degradation of a Syringylcoumaran, a Lignin Substructure Model, by *Fusarium solani* M-13-1,**

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Tech. Bull. Fac. Agr. Kagawa Univ., **37**, 123 (1986)

Side chain reactions of syringylcoumarone and propiosyringone derivatives, which are the degradation intermediates of 5-formyl-3-hydroxymethyl-2-(4-hydroxy-3,5-dimethoxyphenyl)-7-methoxycoumaran(1), a lignin substructure model, mediated by *Fusarium solani* M-13-1 were investigated. The fungus was shake-cultured in mineral salts medium which contained 5-formyl-3-hydroxymethyl-2-(4-hydroxy-3,5-dimethoxyphenyl)-7-methoxycoumarone(2), 3,5-diformyl-2-(4-hydroxy-3,5-dimethoxyphenyl)-7-methoxycoumarone(3) or 2-(5-formyl-2-hydroxy-3-methoxyphenyl)-3-hydroxy-1-(4-hydroxy-3,5-dimethoxyphenyl)-1-propanone(4) as sole carbon source. The α' -aldehyde group of 2 and 3 were oxidized and/or reduced to give the corresponding carboxylic acid and/or primary alcohol. The γ -alcohol of 2 was oxidized to the γ -aldehyde. Propiosyringone derivative 4 was nonenzymatically dehydrated between C_β - C_γ to give the corresponding propenosyringone derivative(10).

T. KATAYAMA, M. SOGO and T. HIGUCHI: **Degradation and Stereoselective Reduction of an α -Ketone Derivative of Guaiacylglycerol- β -Vanillin Ether, a Lignin Substructure Model, by *Fusarium solani* M-13-1**, *Holzforschung*, **40**, 175 (1986)

Degradation of 2-(4-formyl-2-methoxyphenoxy)-3-hydroxy-1-(4-hydroxy-3-methoxyphenyl) 1-propanone(1), an α -ketonic lignin substructure model as an intermediate in lignin biodegradation, by *Fusarium solani* M-13-1 was investigated. Compound 1 was completely degraded, and three catabolic products were identified spectrometrically by comparison with synthetic standard compounds. Based on the products identified, a degradation pathway for 1 is proposed: α' -Aldehyde group of 1 was oxidized to the carboxyl group followed by the reduction of α -ketone group to the hydroxyl group to form guaiacylglycerol- β -vanillic acid ether(4). Reduction of the aldehyde to the primary alcohol was found to be minor. Further, 4 was cleaved between C_α and $C_{\alpha'}$ to give glycerol-2-vanillic acid ether (5). Glyceric acid-2-vanillic acid ether(6) was not detected. The *erythro*/*threo* ratio of the product 4 determined by ^{13}C -NMR spectrometry was 4: 1, indicating that the reduction of the α -ketone was stereoselective.

T. KATAYAMA, S. KAWAI, M. SOGO and T. HIGUCHI: **Degradation of Guaiacylglycerol- α -Vanillyl Alcohol- β -Vanillin Diether, a Lignin Substructure Model Containing a Non-Cyclic Benzyl Aryl Ether, by *Fusarium solani* M-13-1**, *Mokuzai Gakkaishi*, **33**, 503 (1987)

A trimeric lignin substructure model containing a non-cyclic benzyl aryl ether linkage, guaiacylglycerol- α -vanillyl alcohol- β -vanillin diether (1), was synthesized, and its degradation by *Fusarium solani* M-13-1 was investigated. A trimeric adduct

(9) was prepared by the addition of 1-ethoxyethyl vanillyl ether (8) to a quinone-methide (4) from guaiacylglycerol- β -vanillin ether (2). After separation of *erythro* and *threo* forms of the adduct 9 by thin layer chromatography (TLC), the 1-ethoxyethyl protecting group was cleaved by hydrolysis to give 1 which was analyzed by proton (^1H) and carbon 13 nuclear magnetic resonance ($^{13}\text{CNMR}$) spectroscopy. Compound 1 as the sole carbon source was completely degraded by *F. solani* M-13-1, and 2-(4-carboxy-2-methoxyphenoxy)-3-hydroxy-1-(4-hydroxy-3-methoxyphenyl)-1-propanone (12) was isolated and identified as the main catabolic product. From a control solution without the fungus, guaiacylglycerol- β -vanillin ether (2) and vanillyl alcohol (13) were obtained as the main products. We think that the benzyl aryl ether of 1 was initially cleaved by two modes, oxidative fission mediated by a phenol-oxidizing enzyme, and non-enzymic hydrolysis. The resulting 12, 2, and 13 may be degraded further *via* previously found pathways.

T. KATAYAMA, F. NAKATSUBO and T. HIGUCHI: **Degradation of a Phenylcoumaran, a Lignin Substructure Model, by *Fusarium solani* M-13-1**, *Mokuzai Gakkaishi*, **32**, 535 (1986)

Degradation of a phenylcoumaran, one of the main substructures in lignin, by *Fusarium solani* M-13-1 was investigated. The fungus was shake-cultured in a mineral salts medium which contained 5-formyl-3-hydroxymethyl-2-(4-hydroxy-3,5-dimethoxyphenyl)-7-methoxycoumaran (1) as the sole carbon source. Catabolic products of 1 were identified by NMR and mass spectrometry in comparison with synthetic standard compounds; degradation pathways of 1 are proposed. The aldehyde group of 1 was oxidized to 5-carboxy-3-hydroxymethyl-2-(4-hydroxy-3,5-dimethoxyphenyl)-7-methoxycoumaran (3) or reduced to 3,5-dihydroxymethyl-2-(4-hydroxy-3,5-dimethoxyphenyl)-7-methoxycoumaran (2). 3-Hydroxymethyl-2-phenylcoumarone derivatives (4, 5, and 6), 5-carboxy-2-(4-hydroxy-3,5-dimethoxyphenyl)-7-methoxycoumarone (10), and 2-(5-formyl-2-hydroxy-3-methoxyphenyl)-3-hydroxy-1-(4-hydroxy-3,5-dimethoxyphenyl)-1-propanone (11) were isolated and identified as catabolic intermediates. Their formation was ascribed to the following reactions: Dehydrogenation and subsequent disproportionation of 1, 2, and 3 gave their quinonemethide derivatives (18), which were converted to 4, 5, and 6 by dehydrogenation of a β -proton, to 10 by release of formaldehyde from the γ -position, and to 11 by the nucleophilic addition of H_2O to α -carbon, respectively. 3-Formyl-2-phenylcoumarone derivatives (7, 8, and 9) were formed similarly by the further dehydrogenation of the 3-hydroxymethyl-2-phenylcoumarone derivatives (4, 5, and 6). 5-Carboxyvanillic acid (12), syringic acid (13), and 2,6-dimethoxy-*p*-benzoquinone (14) identified as degradation products of 1 were ascribed to the cleavage of C_α -

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C_β and C_α - C_{aryl} bonds.

T. NOMURA, M. TOMAZELLO and A. AZZINI: **Production and Utilization of Bamboo in Brasil**. Proceedings of the Project Group P 5.04, Production and Utilization of Bamboo and Related Species, XVII IUFRO World Congress, Ljubljana, Yugoslavia, September 7-21, 1986.

T. NOMURA: **Present Condition of Forest Resources and Utilization of Bamboo in Brasil**. New Lumber Man, vol. 17, No. 62, 1 (1987) (in Japanese)

In Brasil, 3.6 million of forest diminished annually. But, reforestation was only 0.5 million ha until 1962. From 1962 to 1982, reforestation was attained 4.5 million ha. Especially, after 1979, more than 0.4 million ha was reforested per year. Nevertheless, the balance is about 3 million ha diminution.

The species for reforestation is almost always exotic, which are mainly *Eucalyptus* and *Pinus*. Growth rate of pine, for example, may exceed 30 m³/ha/year and *Eucalyptus* about 60 m³/ha/year are possible in plantations with good condition. But, in the present condition, growth rate of *Eucalyptus* is not so good and estimated about 15 m³/ha/year.

Bamboo is the most profitable as an alternative to other forest products. It grow up in 30-80 days in single culm species of monopodial type, and in 80-110 days in clumpforming ones of sympodial type. For example, in the case of *Dendrocalamus latifloras*, with good site condition, harvesting amount is 47 m³/ha/year.

T. YAMADA (Editor): **Science of Wood-produced Environment**, Kaiseisha (1987), 484p (in Japanese)

This book provides a comprehensive guide to sensuous properties of wood-produced environments, and house clima, along with that to the effect of wood-produced environment on vital phenomena.

H. YANO, M. NORIMOTO and T. YAMADA: **Changes in Acoustical Properties of Sitka Spruce due to Acetylation**, Mokuzai Gakkaishi, 32, 990 (1986)

Ethanol-benzene extracted Sitka spruce was acetylated with uncatalyzed acetic anhydride at 120°C and dried after the reaction in a vacuum at 70°C over P₂O₅. Specimens with weight gains due to acetylation of 0.7 to 24.9 percent were produced. Acoustical properties were evaluated by the specific dynamic Young's modulus and by logarithmic decrement. Each was measured by the free-free flexural vibration method.

For oven-dried specimens, both specific dynamic Young's modulus and logarithmic decrement decreased with increasing degrees of acetylation. In control

specimens, as the relative humidity increased, the specific dynamic Young's modulus decreased whereas the logarithmic decrement increased. Changes in the quantities of these two evaluaters for acetylated specimens was not as much as those of the control specimens, especially at high levels of acetylation.

Frequency dependence of the specific dynamic Young's modulus and the logarithmic decrement in the range of 470 to 6400 Hz were not affected by acetylation.

The results of this study indicate acetylation improves the acoustical properties of Sitka spruce.

M. NORIMOTO, F. TANAKA, T. OHOGAMA and R. IKIMUNE: **Specific Dynamic Young's Modulus and Internal Friction of Wood in the Longitudinal Direction**, Mokuzaï Kenkyu Shiryo (Wood Research and Technical Notes), No. 22, 53 (1986)

The purpose of this investigation is to examine the effects of the cell wall structure including crystallinity, microfibril angle in S_2 layer, proportion of S_2 layer, and values of elastic constants of matrix on specific dynamic Young's modulus and to clarify the mechanism of internal friction in wood. According to the results estimated using a cell-wall model, specific Young's modulus depended remarkably on microfibril angle in S_2 layer, but slightly on the other factors. Therefore, it was considered that the main reason for the variation of specific dynamic Young's modulus resulted from the variation of microfibril angle in S_2 layer. To ascertain this experimentally, average microfibril angle and dynamic mechanical properties such as dynamic Young's modulus and internal friction of Hinoki wood (*Chamaecyparis obtusa*) from the thinning operation were measured by X-ray diffraction and by a flexural vibration of a free-free beam, respectively, and specific dynamic Young's modulus was plotted against average microfibril angle. The experimental results showed a good agreement with the calculated ones. Furthermore, it was found that there was also a good correlation between internal friction and average microfibril angle in S_2 layer. With reference to these results, it was considered that internal friction in wood resulted from time lag between deformations of framework and matrix in S_2 layer, and the effect of microfibril angle in S_2 layer on internal friction was discussed.

M. NORIMOTO: **Specific Young's Modulus and Quality of Coniferous Wood**, Mokuzaï Gakkaishi, 33, 545 (1987)

Relationship between Young's modulus and specific gravity of coniferous wood was investigated in relation to wood structure, and evaluation of wood quality concerned with strength properties, acoustical properties and bending quality by specific Young's modulus was discussed.

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G. ZHAO, M. NORIMOTO, F. TANAKA, T. YAMADA and R.M. ROWELL: **Structure and Properties of Acetylated Wood I. Changes in the Degree of Crystallinity and Dielectric Properties by Acetylation**, *Mokuzai Gakkaishi*, **33**, 136 (1987)

Small Sitka spruce (*Picea sitchensis* Carr.) wood specimens were acetylated by immersing them in acetic anhydride for various periods of time at 120°C. Change in the structure and properties of the treated specimens with weight gains were investigated.

The oven-dry specific gravity, volume, and dimensions in the three principal directions of the acetylated specimens increased linearly with increasing weight gains in the range of 7 to 26%. The degree of crystallinity remained unchanged up to a 25% weight gain but decreased slightly at 26.8%. Bending modulus of elasticity, specific modulus of elasticity, and specific strength parallel to the grain of the treated specimens in an oven-dry condition decreased slightly with weight gain, but there were no reductions in strength and maximum strain. The oven-dry dielectric dispersion magnitude at -60°C, which is proportional to the number of methylol groups in the noncrystalline region, decreased linearly with weight gains. On the other hand, the generalized relaxation time due to the orientation of the methylol groups decreased slightly up to about 14% weight gain and increased rapidly above 14%. The dielectric constant and equilibrium moisture content at 62% relative humidity had a pronounced reduction by acetylation.

T. MOROOKA, M. NORIMOTO and T. YAMADA: **Cyanoethylated Cellulose Prepared by Homogeneous Reaction in Paraformaldehyde-DMSO System**, *J. Applied Polym. Sci.* **32**, 3575 (1986)

A series of cyanoethylated cellulose with various degree of substitution was prepared by homogeneous reaction of cellulose in PF/DMSO system. Their thermal deformation properties changed regularly with the degree of cyanoethylation. By comparing highly cyanoethylated cellulose in the series with the prepared by a traditional cyanoethylation method, it was seen that they were quite different in physical properties such as thermal deformation or tensile properties. Based on the results of dynamic mechanical measurements and infrared spectroscopy, cyanoethylated cellulose prepared in PF/DMSO system was found to be a new cellulose derivative, which includes oligo-oxymethylene groups at the position between the glucopyranose ring and the cyanoethyl group in the side chain. The maximum DS value of this cyanoethylated cellulose was estimated to be ca.2.5.

M. HATA and H. SASAKI: **Structural Analysis of Racking Behavior of Nailed Stressed-Skin Panels and Behavior of Transmitted Forces through Nails I.**, *Mokuzai Gakkaishi*, **33**, 12-18 (1987) (in Japanese with English summary)

A new analytical method of numerical analysis is presented to clarify the mechanical behavior of sheathed walls with a plywood facing nailed on a wood frame structure subjected to a racking shear force. The new method is comprised of the following two finite elements of structural analysis: (1) Force-displacement analysis of the wood-frame structure with semi-rigid properties at the joints of members. (2) Two-dimensional structural analysis of the facing idealized with a hybrid of the usual triangular elements and special triangular elements (GUZUMI-elements) which have a loose corner representing the mechanical behavior of a nailing point.

The horizontal displacement required is given to a top corner of the frame, and the displacements of all nailing points on the frame are calculated by Analysis (1), then Analysis (2) is made by restraining the displacements at the nailing points of the facing with those of the frame calculated by Analysis (1). The reaction forces at nailing points obtained by Analysis (2) are fed back to Analysis (1) as additional restraining forces at the nailing points of the frame.

In each cycle calculations, the elastic modulus of two-directional springs, which are attached at a corner of each GUZUMI-element to represent the mechanical behavior of a nailed joint, are revised according to the non-linearity in load-displacement relation of a nailed joint which is expressed as

$$P = a \{1 - \exp(-d/b)\}$$

where P is a shear force, d is the relative shear displacement between nailed-joint members, and a and b are experimental constants 105 kgf and 0.255 mm, with N50 nails, respectively.

The load-displacement curves calculated on nailed stressed-skin panels with dimensions of 300 × 600 mm and 6 or 12 nails coincided well with the those obtained by experiment, and the feasibility of this new numerical method for analysing the mechanical behavior of nailed stressed-skin panels was verified.

N. SUZUKI and H. SASAKI: Calculation of Fracture Toughness of Bending Specimens with Central Crack in a Sliding Mode by Finite-Element Method I. Stress distribution of specimens and calculation of fracture toughness by J-integral method, Mokuzai Gakkaishi, 33, 182-187 (1987) (in Japanese with English summary)

The stress distribution in specimens for the measurement of fracture toughness in a sliding mode (these specimens were reinforced with soft steel plates to prevent bending fracture) was investigated by the finite-element method (FEM). The fracture toughness in a sliding mode (G_{IIc}) also was calculated by the J-integral method. Results are summarized as:

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1. Because the cleavage stress, σ_y acting near the crack tip was small, the crack tip was in a pure sliding mode.

2. Because the concentration of shearing stress near the crack tip is small when the crack length is short, a fracture is not apt to occur starting from the crack tip.

3. All G_{IIc} calculated by the J-integral method were close to those measured by the torsional test when the crack length was 12 cm, and were suited for a standard of estimating bonding strength.

N. SUZUKI and H. SASAKI: **Calculation of Fracture Toughness of Bending Specimens with Central Crack in a Sliding Mode by Finite-Element Method II. Calculation of fracture toughness by stress method and by displacement method**, *Mokuzai Gakkaishi*, **33**, 188–192 (1987) (in Japanese with English summary)

Fracture toughness values which were calculated by the stress method and the displacement method were compared with those calculated by the J-integral method. Results are summarized as:

1. The fracture toughness values calculated by the stress method and the displacement method were identical with those calculated by the J-integral method.

2. In the specimen whose crack length was less than 8 cm, the stress intensity factor and the strain energy release rate was less than the critical value.

3. As the fracture toughness measured by the bending test increased with increasing crack length, the intact fracture toughness could not be used as a characteristic value of strength. Therefore, the fracture toughness had to be revised in consideration of the plasticity at the crack tip.

4. The specimen whose crack length was 12 cm was satisfactory for the measurement of fracture toughness.

N. SUZUKI and H. SASAKI: **Fracture of Notched Wooden Beams with Glue Lines**, *Mokuzai Gakkaishi*, **33**, 291–297 (1987) (in Japanese with English summary)

Bending tests with concentrated center loads were made on taiwan hinoki (*Chamaecyparis* sp.) and mountain ash (*Fraxinus* sp.) double-notched (beveled) beam specimens with various notch apex angles. Each specimen was made of two pieces of wood glued with resorcinol-resin adhesive along a line through the notch apexes. The failure criterion at the notch apex is discussed with stress distribution calculated by the finite-element method. Furthermore, an improvement in strength of the beams was made by reinforcing the notches with a flexible epoxy-resin adhesive. Results are summarized as:

1. When angle of the notch apex is 90°, fracture is caused mainly by opening deformations (Mode I). The role of the opening deformation of the fracture of

beams decreases with increasing angles of the notch apex.

2. The fracture load predicted by a proposed criterion, $\beta_1(K_A/K_{AC})^2 + \beta_2(K_B/K_{BC})^2 = 1$, coincides well with the experimental results.

3. Filling kerfs made at the notch apexes with flexible adhesive is greatly effective in improving the strength of notched wooden-beams.

S. ISHIHARA: **Reducing Flammability of Structures**, Proceedings of S5.03-04 Session, The 18th IUFRO World Congress, p. 69-76, September 9, 1986, Ljubljana, Yugoslavia

The background for considering fire progression in the overall fire reduction of constructions, members or elements is briefly described. Fire spread in construction, reducing flammability of construction, requirements of Japanese code for construction, and current researches on fire retardant treatment in Japan are also reviewed.

N. KOBAYASHI and S. ISHIHARA: **A Weather-resistant Amino-phosphonate-based Wood Fire Retardant**, Proceedings of S5.03-04 Session, The 18th IUFRO World Congress, p. 31-48, September 9, 1986, Ljubljana, Yugoslavia

Through our preliminary research, the two most suitable main two components of our weather-resistant fire-retardant formulation have been found to be firstly 3-(dialkyl-phosphono) propionamide, or its derivatives, and secondly aqueous soluble amino resins.

Subsequent selection was done by means of a specially contrived one day screening test, since possible latitudes of the formulations exceeded 100,000. This test involved firstly immersing room temperature cured film in water, and secondly exposing the film to ultra-violet ray, and thirdly measuring weight remaining rate and phosphorous retention.

This improvised single day test has been found equivalent to a 1000 hour accelerated weathering test of fire-retardant coated wooden test decks, which in turn corresponds to some 3-5 years of actual outdoor weathering. An optimum formulation was finally established from the standpoint of the type of main components, their mixing ratio, type & amount of acidic catalyst, the range of pH and suitability of various additives. Moreover, through testing, the coincidence between the phosphorous retention in the said film screening test and the resistance to actual outdoor weathering of fire-retardancy of coated wooden decks was confirmed.

One important source of adverse influence has come to light during testing, namely, the calcium (bi) carbonate and/or sodium (bi) carbonate often to be found in the city main water supply which is used for artificial rain tests. In this

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report the use of deionized water for such tests is proposed.

S.P. TAKINO: **Mechanical Properties of Stressed-Skin Panels for Interior of Concrete Apartments**, Mokuzai Kenkyu Shiryo (Wood Research and Technical Notes), No. 24, 10 (1986) (in Japanese)

Mechanical properties of stressed-skin floor and wall panels for interior of concrete apartments were reviewed. They were tested by static bending tests, impact test, fatigue test and creep test.

S.P. TAKINO, M. MASUDA and T. FUYUKI: **Creep Properties of Stressed-Skin Panels under a Concentrated Load**, Mokuzai Kenkyu Shiryo (Wood Research and Technical Notes), No. 24, 145 (1986) (in Japanese)

Creep properties under a concentrated load of stressed-skin floor panels for interior of concrete apartments were described.

S. KAWAI, H. SUDA, M. NAKAJI and H. SASAKI: **Production Technology for Low-density Particleboard II. Effects of particle moisture content and resin content on board properties**, Mokuzai Gakkaishi, 32, 876-882 (1986) (in Japanese with English summary)

Effects of particle moisture content and resin content on the properties of low-density particleboard bonded with an isocyanate compound resin were investigated. Strand-type particles of lauan (*Shorea* spp.) with an air-dry density of 0.40 g/cm³ were prepared and then conditioned to various moisture contents in the range of 0-24%. Boards with an air-dry density of 0.40 g/cm³ were produced with these conditioned particles, and the effect of the moisture content on the board properties is discussed. Boards with air-dry densities of 0.30 and 0.40 g/cm³ were produced at four different resin content levels in a range of 3-15%. Furthermore, boards were produced by use of model particles of uniform geometry at the different resin contents, to examine the influence of particle configuration and preparation in relation to the resin content. The results obtained were as follows;

1) The suitable moisture content range was very broad. The board properties were sufficiently stable at moisture contents of 8-23%. The optimum moisture content was found to be in the range of 12-20%.

2) With an increase of resin content, the board properties were improved. This improvement was found to be closely related to the particle quality and configuration in regard to mechanical strength, whereas the thickness swelling was independent of these factors under these experimental conditions.

H. SUDA, S. KAWAI and H. SASAKI: **Production Technology for Low-density Particleboard III. Effect of particle geometry on board properties**, Mokuza Gakkaishi, **33**, 376-384 (1987) (in Japanese with English summary)

Each of twenty-four types of lauan particles with different dimensions, strictly controlled for length (λ), width (ω) and thickness (δ), was used to produce low-density particleboards with a specific gravity of 0.40 using an isocyanate compound adhesive. Mechanical and physical properties of these boards were determined and the effect of particle size and shape on the properties of the boards are discussed. The results are summarized as follows:

1) With the exception of a few extreme conditions, a positive linear relationship was found between the bending strength and a shape factor of particles, $(\pi\lambda/2\delta\omega)^{0.5}$, introduced from the fracture mechanics theory.

2) The internal bond strength increased linearly with the increase of another shape factor, $\delta(\lambda\omega)^{-0.5}$.

3) The thickness swelling of boards, after a 31-day water immersion increased with increasing λ and ω of particles, while the linear expansion of board planes increased with decreasing λ and with increasing δ .

4) In particleboards composed of particles with different distribution models of lengths, the properties of boards were influenced mainly by the average length of particles more than by the type of distribution of particle lengths.

S. KAWAI, H. SUDA and H. SASAKI: **Production Technology for Low-density Particleboard IV. Effects of particle density and compaction ratio on board properties**, Mokuza Gakkaishi, **33**, 385-392 (1987) (in Japanese with English summary)

Balsa (specific gravity, SG=0.21), meranti (SG=0.40), and apitong (SG=0.70) particles of uniform length (λ), 30 mm, width (ω), 7 mm, and thickness (δ), 0.5 mm were pressed into particleboards with specific gravities of 0.1-0.9 by use of an isocyanate compound adhesive of 10% resin content. Effects of particle density and compaction ratio on lowering the board density were investigated. The contributions of the various processing variables to the board properties were estimated by multiple regression analysis, using the results reported in previous papers and this paper. The results are summarized as follows:

The modulus of rupture (*MOR*) and the modulus of elasticity (*MOE*) of boards of each species had linear relationships with the compaction ratio, *CR* (board density, ρ /particle density, ρ_r). The gradient of the regression equation between *MOR* and *CR* for each species was proportional to the *MOR* of the solid wood of each species. The lower limit of the compaction ratio was 0.5 under these conditions for *MOR*, *MOE*, and internal bond strength (*IB*). The thickness

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swelling (TS) after 31 days of water immersion increased linearly with increases of the compaction ratio, and was independent of the species used.

The multiple regression analysis showed that MOR and MOE could be predicted adequately with board density (ρ) and mat bulk-density (BD) as predictor variables ($R^2=0.90$). BD was correlated inversely with the shape factor in bending, $(\pi\lambda/2\delta\omega)^{0.5}$ divided by ρ_r ($r=-0.85$). This suggests that BD might be a handy index to represent the factors of particle density and configuration in relation to the bending strength of boards. IB can be well-predicted with ρ^2 and ρ_r ($R^2=0.93$), and TS can be estimated with four predictor variables, that is, resin content, CR , λ , and δ ($R^2=0.70$).

S. KAWAI, M. NAKAJI, M. NAKAHARA and H. SASAKI: **Properties of Low-density Particleboards Made of different Residues from Plywood Industry**, Mokuzaï Kogyo (Wood Industry), **42**, 313-317 (1986) (in Japanese with English summary)

Seraya (*Shorea* spp.) flakes were prepared from various residues in plywood industry with a knife-ring flaker. The flakes were pressed into particleboards with densities of 0.3-0.5 g/cm³ using an isocyanate compound resin adhesive, and the properties were examined. The results obtained were as follows;

Boards from end logs and core bolts showed the highest in both mechanical properties and dimensional stabilities. The bending strength of these boards with a density of 0.4 g/cm³ was 150 kg/cm², the internal bond strength 5.5 kg/cm², and the thickness swelling in 24 hrs water immersion 8 percent. Boards from veneer residues showed lower internal bond strength and higher thickness swelling.

On the other hand, boards from plywood residues showed high dimensional stabilities, but the bending properties decreased to 75-50% of those from end logs and core bolts.

Y. YOSHIDA, S. KAWAI, Y. IMAMURA, K. NISHIMOTO, T. SATOU and M. NAKAJI: **Production Technology for Acetylated Low-density Particleboard I. Mechanical properties and dimensional stability**, Mokuzaï Gakkaishi, **32**, 965-971 (1986) (in Japanese with English summary)

Seraya (*shorea* spp.; air dry-density=0.51 g/cm³) particles were treated with acetic anhydride to produce a 16% weight gain in acetic groups. Acetylated, non-acetylated, and mixed (50: 50 weight ratio) particles were pressed into low-density particleboards with densities of 0.4 and 0.5 g/cm³ using polymeric-type urethane resin adhesive. Physical properties of the boards were determined.

Results were as follows:

- 1) The modulus of rupture (MOR) of boards decreased slightly due to the

acetylation treatment. No difference in internal bond strength between acetylated and non-acetylated boards was observed at approximately equal density levels. Note that the dimensions of acetylated particles were changed (that is, chips were broken) during the acetylation process and that the compaction ratio of treated boards became lower. *MOR* seems to be influenced by the two above-mentioned factors.

2) The average retention of *MOR* in wet-bending of acetylated boards was 86%, which was higher than that of control boards.

3) Acetylated particleboards show great dimensional stability. Hysteresis of thickness swelling was observed rarely after and during immersion in water for a 24-hour period. It can be said that acetylated particleboards performed like solid wood.

This experiment showed that great water-repellency and dimensional stability of particleboards can be obtained by the chemical modification of particles through an acetylation process. Effects of the change of particle dimensions and great water-resistance of the adhesive used also was observed.

M. TAKAHASHI: **Fungal Decay Types, Their Significance in Wood Preservation**, Mokuizai Kenkyu Shiryo (Wood Research and Technical Notes), No. 22, 19 (1986) (in Japanese)

Characteristics of various wood-deteriorating microorganisms are described. Formation and action of the cellulolytic and ligninolytic systems in wood-decaying fungi are discussed on the aspects of fungal evolution and wood preservation. Elucidation of the unique decay mechanism in brown-rot fungi should be promoted because they are causing severe damage of wooden buildings.

M. TAKAHASHI: **Biology of Wood Decay**, Shiroari (Termite), No. 64, 15, and No. 65, 21 (1986) (in Japanese)

Firstly, structure and chemical constituents of wood are described to understand the biological aspects of wood decay. Secondary, taxonomic status and physiological identity in the wood-decaying fungi are discussed. Finally, physical and chemical alterations in decayed wood are described.

M. TAKAHASHI: **Wood Preservation in Indonesia**, Mokuizai Hozon (Wood Preservation), 13, 30 (1987) (in Japanese)

Biological resistance of important commercial timbers in Indonesia, and current trend in preservative wood treatment in this country are described showing several tables and figures.

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K. TSUNODA, H. DOKI and K. NISHIMOTO: **Effect of Developmental Stages of Workers and Nymphs of *Reticulitermes speratus* (Kolbe) (Isoptera: Rhinotermitidae) on Caste Differentiation Induced by JHA Treatment**, Material und Organismen, **21**(1), 47 (1986)

The effect of different instars on caste differentiation when workers or nymphs of *Reticulitermes speratus* (Kolbe) were exposed to a filter paper treated with a juvenile hormone analogue (JHA) [ethyl(2-(p-phenoxy phenoxy) ethyl) carbamate] in the dark at $26^{\circ}\pm 1^{\circ}\text{C}$ for 3 weeks was studied. Presoldiers were induced from every instar of workers obviously under the influence of JHA with a peak at the 5th instar. In JHA treatments living workers without molting tended to increase with increasing instar. On the other hand, JHA seemed to have little effect on the mortality of the workers. JHA could induce the presoldier differentiation from all developmental stages of nymphs, although only two presoldiers were produced from the final instar group in the acetone controls. When exposed to JHA the highest potential of caste differentiation was recorded in the final instar group. Thus, the caste-differentiating potential was ascertained in every instar group of workers and nymphs and a maximum was obtained at a certain period of time during the course of development. The results subsequently would suggest the applicability of JHA as a termite control measure since the disturbance of caste differentiation seems to result in the collapse of the whole termite colony.

K. TSUNODA, S. ICHIKAWA and K. NISHIMOTO: **Shipworm Attack on Logs Stored in the Sea Water and Its Prevention (6)-Influence of Various Chemicals on Shipworm Larvae**, Mokuzai Kogyo (Wood Industry), **42**, 19 (1987) (in Japanese)

Approximately 300 chemicals were tested for their effects on shipworm larvae in the laboratory. When chemicals were added to non-running sea water, organotin compounds, ziram and thiram were highly effective even at low concentrations. Among these, the last candidate was considered potential practically, and it proved satisfactorily effective at 0.05 ppm by adding the chemical to running water.

K. TSUNODA and K. NISHIMOTO: **Fungicidal Effectiveness of Amended Alkylammonium Compound**, The Int. Res. Group on Wood Preserv. Document No: IRG/WP/3421 (1987)

Amendment of didecyldimethylammonium chloride was attempted to improve its fungicidal effectiveness and properties of treating solutions. Addition of copper definitely increased effectiveness in controlling wood decay fungi, although metal corrosiveness and stability of treating solutions was unsatisfactory.

Further amendment with stabilizer(s), anticorrosive agent(s) and sequestering agent(s) resulted in improving fungicidal effectiveness as well as properties of

treating solutions. When a wood block was impregnated with an adequate mixture of didecyldimethylammonium chloride, copper sulphate, sequestering agent, stabilizer and anticorrosive agent (1 : 0.5 : 0.5 : 1 : 0.25), laboratory test (JIS A 9302) indicated that a lower retention level of didecyldimethylammonium chloride (1.1 kg/m^3) gave a satisfactory protection to the block from decay fungi. On the other hand, didecyldimethylammonium chloride itself was effective enough at higher retentions of $2.2 \sim 4.3 \text{ kg/m}^3$.

K. TSUNODA and K. NISHIMOTO: **Effectiveness of Alkylammonium Compounds as Above-Ground Wood Preservatives**, Mokuzaï Gakkaishi, **33**, 589 (1987)

Three kinds of commercial alkylammonium compound (AAC) formulations were tested for their potential use as wood preservatives for protecting timber used in above-ground situations according to methods developed by the New Zealand Forest Research Institute and a newly-designed feeder-board technique. Effectiveness of the formulations against termite and lyctus attacks also was evaluated in the laboratory

Didecyldimethylammonium chloride was by far the most effective against the brown-rot fungus, *Tyromyces palustris* (Berk. et Curt.) Murr. A comparison of AAC and copper-chromium-arsenate (CCA), a proprietary water-borne wood preservative, showed that the former was less effective than CCA in controlling a white rot under simulated above-ground conditions, as didecyldimethylammonium chloride could not protect timber at a retention of 2.5 kg/m^3 .

Termite attacks were restrained at a retention of 2.2 kg/m^3 , and no weight loss of treated wood-blocks was observed with approximately 33% mortality of termites at a 4.3 kg/m^3 retention.

K. TSUNODA: **Some Recent Trends in Development of Anti-mold and Anti-Sapstain Chemicals**, Mokuzaï Kogyo (Wood Industry), **42**, 396 (1987) (in Japanese)

Intensive efforts have been made to develop new safe anti-mold and anti-sapstain chemicals in various countries. Because high toxicity and environmental impact of conventional chlorinated hydrocarbons are well documented today. A few new combined formulations such as Busan products, Senesto B and Kopper NP-1 seem potential since they have proved effective in controlling mold and sapstain fungi on sawn timber in practical sawmill trials. Recent trials with these new products in Australia, New Zealand and North America are reviewed and discussed.

T. YOSHIMURA, K. TSUNODA and K. NISHIMOTO: **Effect of Molybdenum and Tungsten Compounds on the Survival of *Coptotermes formosanus* Shiraki**

ABSTRACTS

(Isoptera: Rhinotermitidae) in Laboratory Experiments, Material und Organismen, 22(1), 47 (1987)

Effects of molybdenum and tungsten compounds on the termite, *Coptotermes formosanus* Shiraki were examined. Sodium molybdate and sodium tungstate were effective in diminishing the activity of *C. formosanus*, though the compounds acted very slowly on termites. They caused 100% mortality of *C. formosanus* workers after feeding them on 5% treated filter paper for only one day. The slow-acting effectiveness of the compounds may suggest their applicability in the bait-block technique for controlling termite attacks. A remarkable discoloration of the abdomen was observed with termites fed on the sodium molybdate-treated filter papers and wood blocks, possibly because of the characteristics of the chemical.

Y. IMAMURA: **Biodeterioration of Particleboard**, Mokuzai Kogyo (Wood Industry), 42, 306 (1987) (in Japanese)

Biodeterioration of particleboard was reviewed. Among the factors affecting the resistance of particleboard against decay fungi and termites, the type of adhesive and its content were shown to have large effects on resistance.

It was stressed that strength reduction was not always associated with weight loss of the sample, suggesting deterioration of the wood-glue bond. A newly-designed test method was proposed to evaluate the mechanical performance of particleboards under fungal attack.

Y. IMAMURA and K. NISHIMOTO: **Bending Properties of Acetylated Particleboards Exposed to Decay Fungi**, Mokuzai Gakkaishi, 33, 25 (1987) (in Japanese with English summary)

Spruce particleboards were made from mixtures of untreated and acetylated chips (at 17 percent acetyl weight gain) using three types of adhesives of urea-melamine formaldehyde (UMF), phenol-melamine formaldehyde (PMF), and isocyanate (Is) resins. The mixing ratios of acetylated chips were 0, 25, 50, 75, and 100 percent as weight proportion. Bending properties of boards were measured according to JIS (Japanese Industrial Standard) A 5908, and strength losses caused by the decay fungi were determined by bending-creep tests under progressive brown-rot fungal attack by *Tyromyces palustris*.

Although the mixture of acetylated chips reduced the bending strength of boards in an air-dried condition for all types of adhesive resins. Is boards had relatively high values even though the proportion of acetylated chips accounted for 100 percent. When exposed to fungal attack, control PMF boards maintained their strength longer than Is and UMF boards, but all control specimens failed within a short time. No difference was detected in deflection-time curves among

UMF boards of different amounts of acetylated chips. PMF and Is boards containing acetylated chips had smaller increases of deflection and failed after a longer time than the control boards. Boards containing only acetylated chips showed a very small deflections after 120 days and little weight losses at the end of this time.

Y. IMAMURA, K. NISHIMOTO and H. MOTOKI: **Termite Resistance of Flakeboards Bonded with Isocyanate Resin**, *Mokuzai Gakkaishi*, **32**, 842 (1986) (In Japanese with English summary)

Termite resistance of spruce flakeboards bonded with polymeric isocyanate resin (MDI) was determined and compared with that of those bonded with melamine-urea formaldehyde resin (MUF) and phenol formaldehyde resin (PF). The boards were exposed to attacks by subterranean termites of *Reticulitermes speratus* Kolbe and *Coptotermes formosanus* Shiraki using two laboratory test methods. These were forced-feeding tests in small vessels according to JWP (Japan Wood Preserving Association) criterion and choice-feeding tests in breeding nests.

Considerable mortality was observed for *R. speratus* when fed on PF and MUF bonded boards, whereas few death were recorded with MDI boards. Mortality of *C. formosanus* adults in all boards was low even after a test period of three weeks. The order of weight loss of boards was MDI, PF, and MUF. The termites ate more of the MDI boards when a choice of binders was available. Increases of the amounts of binder resins from levels of 3 to levels of 9 percent increased termite resistance; especially, the MDI board of large binder content was damaged less severely. Specific gravity of the boards also was correlated with the percent weight-loss in attacks on MDI boards; their relationships were small in MUF and PF boards which showed greater thickness swelling after exposure to termites.

Y. IMAMURA and K. NISHIMOTO: **Biodeterioration of Sheathing-Insulation-board and Its Prevention. Effect of some insecticides on board in laboratory termite tests**, *J. Antibac. Antifung. Agents*, **14**, 489 (1986) (in Japanese with English summary)

Sheathing-Insulationboards are of increasing economic importance for structural panel products and subflooring materials. Without special treatment, they are severely destroyed by decay fungi and termites. In this paper, termite tests were used to determine levels of insecticides required to provide desirable protection to sheathing-insulationboards from termite attack.

One of the most satisfactory methods of preserving boards is by direct addition of emulsified insecticides to the pulp slurry with the usual additives for strength and weatherability. The amount of Phoxim necessary to achieve protection in termite tests for boards was less than 0.01 percent, based on the dry pulp weight.

ABSTRACTS

However, in a plant process which adopted the addition method, even the intended retention at 0.05 percent was not enough for anti-termite efficiency as a result of volatilization of insecticidal chemicals while of boards were heated for drying.

Treatment of sheathing-Insulationboards by surface coating with some insecticides mixed with wax emulsion was also applied during a finishing process, and it was shown that 0.75 percent of Chlorpyrifos imparted sufficient effectiveness for termite resistance to the boards at the application level of 100 g/m².

R. YAMAOKA, M. TOKORO and K. HAYASHIYA: **Determination of Geometric Configuration in Minute Amounts of Highly Unsaturated Termite Trail Pheromone by Capillary Gas Chromatography in Combination with Mass Spectrometry and Fourier-Transform Infrared Spectroscopy**, J. Chromatogr., **399**, 259 (1987)

A new method for determination of the stereochemistry of each double bond in minute amounts of highly unsaturated termite trail pheromone is discussed. Micro-chemical reactions, acetylation and partial hydrogenation of the isolated termite trail pheromone, followed by capillary gas chromatography-mass spectrometry (GC-MS) and gas chromatography-fourier-transform infrared spectroscopy analyses of the products are the main procedures employed. The number of double bonds in each partially hydrogenated peak is determined by GC-MS, and the presence or absence of a *trans* double bond in the corresponding total absorbance monitoring peak is determined from the infrared absorption around 970 cm⁻¹. The structure of the termite (*Reticulitermes speratus*, Isoptera) trail pheromone was determined as *cis*-3, *cis*-6, *trans*-8-dodecatrien-1-ol.

Research Facility for Wood Protection: **Biology of Termites (15)-Feeding Relationships and Radioisotope Techniques**, Kankyo Kanri Gijutsu (Jour. Environ. Control Tech.), **4**, 303 (1986) (in Japanese)

The second Japanese abstract of chapter 12-"Feeding Relationships and Radioisotope Techniques" in the book, "Biology of Termites (vol. 1)" is concerned with the applied techniques of radioisotope for understanding food exchange mechanisms among termite individuals.

Research Facility for Wood Protection: **Biology of Termites (16,17)-Water Relations in Termites**, Kankyo Kanri Gijutsu (Jour. Environ. Control Tech.), **4**, 364 (1986); **5**, 178 (1987) (in Japanese)

Japanese epitomized translations of chapter 14-"Water Relations in Termites" in the book, "Biology of Termites (vol. 1)" outline the following aspects: significance of water for termites, resistance of termites against drying conditions, behavior of termites during drying and others.